CLAIMS

1. An adjustment optical disc for an optical pick-up wherein plural recording tracks are concentrically formed.

2. The adjustment optical disc for optical pick-up as set forth in claim 1, wherein, at the disc, information are respectively recorded at the respective recording tracks as plural pits which are multiple of integer of uni pit length.

3. The adjustment optical disc for optical pick-up as set forth in claim 1, wherein, at the respective recording tracks, there are respectively recorded information indicating positions in a radial direction of corresponding ones of the respective tracks from the center of the disc.

4. An adjustment method for an optical pick-up, wherein in the state where a light source of an optical pick-up including the light source for emitting light beams, an object lens for irradiating light beams onto an optical disc for adjustment and a drive portion for driving the object lens in a direction in parallel to an optical axis of the object lens and in a direction perpendicular to the optical axis is movably held with respect to the object lens, and the drive portion is movably held with respect to the light source,

light beams are irradiated from the optical pick-up onto the adjustment optical

disc concentrically having recording tracks to adjust relative position of the object lens with respect to the light source and inclination of the optical axis of the object lens.

5. The adjustment method for optical pick-up as set forth in claim 4, wherein at preceding stage for irradiating light beams from the optical pick-up onto the adjustment optical disc to carry out adjustment, light beams irradiated from the optical pick-up are detected by an image pick-up portion to thereby carry out rough adjustment relating to relative position of the object lens with respect to the light source.

6. The adjustment method for optical pick-up as set forth in claim 5, wherein the light source comprises a semiconductor laser and an optical element for separating light beams emitted from the semiconductor laser into at least the 0-th order light and the ±1-st order light thus to carry out adjustment to allow the light source and the center of the image pick-up portion to be in correspondence with each other after the rough adjustment of relative position of the object lens with respect to the light source is carried out.

7. The adjustment method for optical pick-up as set forth in claim 6, wherein after the rough adjustment has been carried out, light beams are irradiated from the optical pick-up onto the adjustment optical disc to carry out fine adjustment relating to relative position of the object lens with respect to the light source on the basis of return light

from the adjustment optical disc.

8. The adjustment method for optical pick-up as set forth in claim 7, wherein the fine adjustment is carried out by rotationally adjusting the light source so that phase difference of ± 1-st order light becomes equal to 180 degrees with 0-th order light of the 0-th order light and the ± 1-st order light irradiated from the optical pick-up onto the adjustment optical disc being as center.

9. The adjustment method for optical pick-up as set forth in claim 8, wherein the fine adjustment is carried out in the state where light beams emitted from the light source focus on the adjustment optical disc by the object lens.

10. The adjustment method for optical pick-up as set forth in claim 9, wherein inclination of the optical axis of the object lens is adjusted on the basis of result obtained by detecting return light from the adjustment optical disc of light beams irradiated from the optical pick-up onto the adjustment optical disc in the state where light beams emitted from the light source after the fine adjustment has been made follow and scan recording tracks of the adjustment optical disc.

11. The adjustment method for optical pick-up as set forth in claim 10, wherein inclination of the optical axis of the object lens is adjusted on the basis of jitter value

of detection output signal obtained by detecting return light from the adjustment optical disc of light beams irradiated from the optical pick-up onto the adjustment optical disc.

12. The adjustment method for optical pick-up as set forth in claim 4, wherein the optical pick-up is adjusted with a certain position such that change of phase difference of ± 1-st order light when 0-th order light is moved from the certain position of the optical disc toward the inner circumferential side of the optical disc and change of phase difference of the ± 1-st order light when the 0-th order light is moved from the certain position toward the outer circumferential side of the optical disc are substantially equal to each other being as reference.

13. An adjustment method for an optical pick-up, wherein in the state where an optical pick-up including a light source for emitting light beams and an object lens for irradiating light beams onto an optical disc for adjustment is assembled on a base unit including a slide base for supporting the optical pick-up, a guide shaft for movably supporting the slide base, a movement mechanism for moving the slide base in a radial direction of the adjustment optical disc and a disc rotation drive mechanism for rotationally driving the adjustment optical disc, light beams are irradiated from the optical pick-up onto the adjustment optical disc concentrically having recording tracks to adjust relative position of the object lens with respect to the light source and inclination of the optical axis of the object lens.

14. The adjustment method for optical pick-up as set forth in claim 13, the method comprising:

holding the base unit and holding the optical pick-up with the guide shaft being as reference in the state where light beams emitted from the light source follow and scan recording tracks of the adjustment optical disc on the basis of detection result of ± 1-st order light of the 0-th order light and the ±1-st order light generated on the basis of light beams emitted from the light source of the optical pick-up, thus to carry out adjustment so that the optical axis of the object lens and light emitting point of the light source are in correspondence with each other;

adjusting position of the optical axis of the object lens by using parallel displacement mechanism for adjusting position of the optical axis of the object lens with respect to direction in parallel to radial direction of the adjustment optical disc and direction perpendicular to the radial direction;

adjusting phase difference of the ± 1-st order light emitted from the optical pick-up;

adjusting the optical axis of the object lens by using swivel mechanism for adjusting inclinations of the optical axis of the object lens with respect to the radial direction of the adjustment optical disc and direction perpendicular to the radial direction; and

fixing the optical pick-up with respect to the base unit to thereby allow the optical pick-up to undergo positioning so that it is located on the base unit.

15. The adjustment method for optical pick-up as set forth in claim 14, wherein relative position of the object lens with respect to the light source and inclination of the optical axis of the object lens with recording track at a middle position in the radial direction of the adjustment optical disc such that phase differences of the ± 1-st order light at the innermost circumferential side and the outermost circumferential side of the adjustment optical disc become equal to each other being as reference.

16. An adjustment apparatus for an optical pick-up comprising:

a base unit including a lens holder for holding an object lens, an elastic supporting portion for permitting the lens holder to undergo elastic displacement in a direction in parallel to optical axis of the object lens and in a plane direction perpendicular to the optical axis thereof, a holder supporting portion for displacably supporting the lens holder through the elastic supporting portion, a slide base where an optical pick-up including a light source for emitting light beams onto an optical disc for adjustment having concentric recording tracks is attached by the holder supporting portion, a movement mechanism for moving the slide base through a guide shaft for movably supporting the slide base, and a base chassis for supporting the movement mechanism;

lens holding means for holding the holder supporting portion of the optical pick-up to thereby carry out position restriction of the object lens;

lens adjustment means for adjusting, through the lens holding means, position

of the optical axis of the object lens and inclination with respect to the adjustment optical disc of the optical axis thereof;

light source holding means for holding the light source of the optical pick-up;

light source adjustment means for adjusting, through the light source holding means, position of the light source and inclination with respect to the optical axis of the object lens; and

detecting means for detecting beam light beams beams emitted from the object lens which has been adjusted.

17. The adjustment apparatus for optical pick-up as set forth in claim 16, wherein the lens holding means comprises a holding portion for holding the holder supporting portion, and the holding portion holds the holder supporting portion in the state caused to three-dimensionally undergo positioning so that relative position between the slide base and the holder supporting portion can be adjusted.

18. The adjustment apparatus for optical pick-up as set forth in claim 17, wherein the lens holding means carries out holding so that there takes place, between the holder supporting portion and the slide base, a predetermined gap such that relative position between the slide base and the holder supporting portion is permitted to undergo movement adjustment when the holding portion holds the holder supporting portion.

19. The adjustment apparatus for optical pick-up as set forth in claim 18, wherein, at the outer circumferential portion of the holder supporting portion, an engagement projection substantially V-shaped in cross section is formed in thickness direction substantially in parallel to the optical axis of the object lens, and an engagement groove substantially V-shaped is formed in a direction substantially in parallel to the principal surface of the holder supporting portion, a holding member of the lens holding means including an engagement recessed portion engaged with the engagement projection of the holder supporting portion, an engagement shaft provided at the engagement recessed portion and engaged with the engagement groove of the holder supporting portion, and an elastic member for permitting the engagement shaft to undergo elastic displacement with respect to the engagement groove.

20. The adjustment apparatus for optical pick-up as set forth in claim 19, wherein, at the slide base and the holder supporting portion, there are respectively provided an engagement hole and an engagement projection which are relatively engaged with a gap such that relative position is permitted to undergo movement adjustment to each other.

21. The adjustment apparatus for optical pick-up as set forth in claim 16, which further comprises an adjustment base on which the base unit is mounted after undergone positioning, chassis holding means for holding the guide shaft of the base

unit to thereby hold the base chassis, and base holding means for holding the slide base.

22. The adjustment apparatus for optical pick-up as set forth in claim 21, wherein the base holding means includes a positioning pin for allowing the slide base to undergo positioning so that it is located at a predetermined position in the axial direction of the guide shaft, and a base holding member for holding the slide base, and

wherein, at the slide base, there is provided a positioning hole with which the positioning pin is engaged.

23. The adjustment apparatus for optical pick-up as set forth in claim 16, wherein the light source holding means includes a light source holding member provided with an engagement pin engaged with the light source and for holding the light source, and

wherein an engagement portion with which the engagement pin is engaged is provided at the light source.

24. The adjustment apparatus for optical pick-up as set forth in claim 16, wherein the lens adjustment mechanism includes a parallel displacement mechanism for moving the optical axis of the object lens with respect to a direction in parallel to radial direction of the adjustment optical disc and a direction perpendicular to the radial direction thereof, and a swivel mechanism for inclining the optical axis of the object

lens with respect to the radial direction of the adjustment optical disc and the direction perpendicular to the radial direction.

25. The adjustment apparatus for optical pick-up as set forth in claim 21, wherein the chassis holding means includes a shaft holding member for holding respective both end sides of the axis direction of the guide shaft of the base unit, and a supporting member for supporting the middle portion of the guide shaft.

26. The adjustment apparatus for optical pick-up as set forth in claim 16, which further comprises a disc rotation drive mechanism for rotationally driving adjustment optical disc having concentric recording tracks.

27. An adjustment apparatus for an optical pick-up comprising:

a base unit including a slide base on which there is attached a drive portion of an optical pick-up including a light source for emitting light beams, a holder at which an object lens for irradiating light beams onto an optical disc for adjustment is provided, the drive portion for driving the holder in a direction in parallel to the optical axis of the object lens and in a direction perpendicular to the optical axis, and a movement mechanism for moving the slide base;

holder holding means for holding the holder of the optical pick-up;

lens adjustment means for moving the holder holding means to adjust position

of optical axis of the object lens with respect to the light source and inclination with respect to an optical disc for adjustment having concentric recording tracks of the optical axis;

light source holding means for holding the light source of the optical pick-up;

light source adjustment means for adjusting, through the light source holding means, position of the light source and inclination with respect to the optical axis of the object lens; and

detecting means for detecting light beams emitted from the object lens which has been adjusted.

28. The adjustment apparatus for optical pick-up as set forth in claim 27, wherein the lens holding means comprises a holding portion for holding the holder supporting portion, and the holding portion holds the holder supporting portion in the state caused to three-dimensionally undergo positioning so that relative position between the slide base and the holder supporting portion can be adjusted.

29. The adjustment apparatus for optical pick-up as set forth in claim 28, wherein the lens holding means carries out holding so that there takes place, between the holder supporting portion and the slide base, a predetermined gap such that relative position between the slide base and the holder supporting portion is permitted to undergo movement adjustment when the holding portion hols the holder supporting portion.

30. The adjustment apparatus for optical pick-up as set forth in claim 29, wherein, at the outer circumferential portion of the holder supporting portion, an engagement projection substantially V-shaped in cross section is formed in thickness direction substantially in parallel to the optical axis of the object lens, and an engagement groove substantially V-shaped is formed in a direction substantially in parallel to the principal surface of the holder supporting portion, a holding member of the lens holding means including an engagement recessed portion engaged with the engagement projection of the holder supporting portion, an engagement shaft provided at the engagement recessed portion and engaged with the engagement groove of the holder supporting portion, and an elastic member for permitting the engagement shaft to undergo elastic displacement with respect to the engagement groove.

31. The adjustment apparatus for optical pick-up as set forth in claim 30, wherein, at the slide base and the holder supporting portion, there are respectively provided an engagement hole and an engagement projection which are relatively engaged with a gap such that relative position is permitted to undergo movement adjustment to each other.

32. The adjustment apparatus for optical pick-up as set forth in claim 27, which further comprises a base for adjustment on which the base unit is mounted after undergone positioning, chassis holding means for holding a guide shaft for movably

supporting the slide base of the base unit to thereby hold the base chassis, and base holding means for holding the slide base.

33. The adjustment apparatus for optical pick-up as set forth in claim 32, wherein the base holding means includes a positioning pin for allowing the slide base to undergo positioning so that it is located at a predetermined position of the axial direction of the guide shaft, and a base holding member for holding the slide base, and

wherein, at the slide base, there is provided a positioning hole with which the positioning pin is engaged.

34. The adjustment apparatus for optical pick-up as set forth in claim 27, wherein the light source holding means includes a light source holding member at which an engagement pin engaged with the light source is provided so that the light source is held, and

wherein an engagement portion with which the engagement pin is engaged is provided at the light source .

35. The adjustment apparatus for optical pick-up as set forth in claim 27, wherein the lens adjustment mechanism includes a parallel displacement mechanism for moving optical axis of the object lens with respect to a direction in parallel to radial direction of the adjustment optical disc and direction perpendicular to the radial direction, and

a swivel mechanism for inclining the optical axis of the object lens with respect to the radial direction of the adjustment optical disc and the direction perpendicular to the radial direction.

36. The adjustment apparatus for optical pick-up as set forth in claim 32, wherein the chassis holding means includes a shaft holding member for holding respective both end sides of the axial direction of the guide shaft of the base unit, and a supporting member for supporting the middle portion of the guide shaft.

37. An adjustment method for optical pick-up wherein when an optical disc for adjustment where recording tracks are concentrically formed is used to adjust relative position between an object lens and a light source of an optical pick-up in which 0-th order light follow and scan the recording tracks of the optical disc by three beams consisting of 0-th order light and ±1-st order light generated from light beams emitted from the light source and inclination with respect to the optical disc of the optical axis of the object lens,

a predetermined recording track of a middle position of radial direction of the optical disc such that changes of phase differences of ±1-st order light at the innermost circumference and the outermost circumference of the optical disc are substantially equal to each other is caused to be reference for adjusting relative position between the object lens and the light source and inclination of the optical axis of the object lens

with respect to the optical disc.

38. The adjustment method for optical pick-up as set forth in claim 37, wherein adjustment is made with a certain position such that change of phase difference of the ±1-st order light when the 0-th order light is moved from the certain position of the optical disc toward the inner circumferential side of the optical disc and change of phase difference of the ±1-st order light when the 0-th order light is moved from the certain position toward the outer circumferential side of the optical disc are substantially equal to each other being as reference.

39. The adjustment method for optical pick-up as set forth in claim 38, wherein when position of the inner circumferential side of the optical disc is R1 and position of the outer circumferential side of the optical disc is R2, the certain position Rx is determined by

$$Rx = 2/\{(1/R1) + (1/R2)\}.$$